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AUXILIARY POWER UNITS FOR FAN OPERATION[1]

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Introduction

Adequate ventilation is essential to the safe and efficient operation of mines. A good ventilating system is especially necessary in mines which liberate explosive gas. According to the Alabama State Inspection Department there were 217 mines operating in 1927, of which 85 were rated as gassy. A number of the operators, realizing that provisions to insure an uninterrupted ventilating current are added safety precautions, have installed or are installing auxiliary or emergency power units for operating mine fans; 35 of the 85 gassy mines are now equipped with one or more sources of auxiliary power for maintaining uninterrupted ventilation.

When it is considered that the State employs 27,000 men in coal mines producing about 20,000,000 tons annually, and that the 35 mines which have installed auxiliary sources of power employ 10,000 men and produce 9,000,000 tons annually, it is readily seen that this safeguard protects more than one-third of the men and about one-half of the State's production. The installation of auxiliary or emergency sources of power for mine fans is an indication of the progressiveness of the coal operator. In gassy mines where some definite provision has not been made to insure continuous fan operation, the installation and maintenance of an auxiliary power unit is strongly recommended.

Sources of Power

In Alabama the normal sources of power for operating fans are steam and electricity, either purchased or developed at the mine. Emergency or auxiliary power units consist of a complete fan installation, electric motors, and steam or internal-combustion engines. Where power is purchased, the normal drive is generally supplied by an electric motor and the auxiliary power by an internal-combustion or a steam engine. Where the power is generated by the operating company, the normal drive may be steam or electricity, and the emergency drive may be purchased electricity or internal-combustion engines.

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Types of Auxiliary Power Units

There are three general sources of power for auxiliary fan drives - namely, electricity, the steam engine, and the internal-combustion engine.

Where steam power is generated for other purposes, the steam engine is generally used to supply the auxiliary driving force. In those mines which have two separate and independent power circuits available, with the necessary wiring in the switch panel to change from one circuit to the other, the normal drive is electricity, either purchased or generated at the mine.

Internal-combustion engines are used in three ways: Direct-connected to the fan shaft, belt or chain connected to the fan shaft, and direct-connected to a generator which supplies electric power to an auxiliary motor. In each installation, later described, the fans are housed in brick or masonry buildings and are protected with explosion doors.

Brief descriptions of several typical installations in Alabama are given in the following pages.

Auxiliary Gasoline Engine Drive

A 3 by 6 foot reversible fan exhausts 98,000 cubic feet of air per minute at an 8-inch water gauge pressure. The normal drive is a 220-horsepower 2,200-volt alternating-current synchronous motor with an enclosed chain drive. A 300-horsepower four-cylinder gasoline engine, running at 1,300 revolutions per minute, is used as an auxiliary drive. The gasoline engine drives through a cone clutch to the driving pulley and then by a 22-inch rubber belt to the driven or fan pulley. The normal and auxiliary drives are on opposite ends of the fan shaft with a sleeve coupling between each drive and the fan.

On account of the pressure on this fan, it quickly reverses if the electric power fails, and runs in the opposite direction for 8 to 10 minutes. The procedure when there is an interruption in power is as follows:

The gasoline engine is started; when the fan comes to a stop, the normal drive is disconnected and the emergency drive is connected. On account of the cumbersome nature of the couplings as originally installed, two men thoroughly familiar with the operation required 20 minutes to make the coupling change. In place of the sleeve couplings, jaw clutches have been installed, and a brake has been put on the fan shaft. The brake stops the fan in three to five minutes, and the clutches may be changed as soon as the fan stops. Where frequently 30 minutes were required to make the change, the installation of the brake and jaw clutches has reduced the time to eight minutes.

Auxiliary Gasoline Engine Generating Electric Power

A 3½ by 9 foot reversible fan exhausts 158,000 cubic feet of air per minute at 3.6-inch water gauge pressure. The normal drive is a 175-horsepower 2,200-volt alternating-current synchronous motor with an enclosed chain drive; the auxiliary drive is a 250-horsepower 2,200-volt alternating-current inductio

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motor with an enclosed chain connection. The two motors are connected on opposite ends of the fan shaft by jaw clutches. The source of power for the auxiliary motor consists of a 350-horsepower six-cylinder gasoline engine direct-connected to a 187-k.v.a. 2,300-volt alternating-current generator.

Provision is made to prevent the fan from reversing and to allow the auxiliary motor to pick up the load by sliding over the fan exhaust a door operated by a crab in the generating room. When the normal power fails, the procedure followed is to open the oil switch, start the gasoline engine and the generator, change the two clutches, and start the auxiliary motor using the generated power. In order to allow the auxiliary motor to come up to speed when driving the fan, the discharge is closed by a steel door over the stack. The total elapsed time in making the change from purchased to generated power on this fan is from 6 to 8 minutes. The emergency generating plant is so arranged that the electric cap lamps can be charged from the generated power.

Steam Drive and Auxiliary Electric Drive

A 13½ by 7 foot reversible fan exhausts 140,000 cubic feet of air per minute at 4.7-inch water gauge pressure. The normal drive is a 17½ by 26 inch 200-horsepower steam engine, belt-connected to the fan shaft which is driven at the rate of 210 revolutions per minute. The auxiliary drive is a 250-horsepower 2,300-volt alternating-current induction motor belt-connected to the fan shaft. The normal and auxiliary drives are on opposite ends of the fan shaft and are connected by jaw clutches.

One man requires three to four minutes to change the fan from normal to auxiliary drive; the change has even been accomplished before the fan stopped. The procedure when the normal or steam drive ceases or breaks is to close the switch, start the electric motor, disengage the clutch on the steam drive, and engage the clutch on the electric drive. The electric drive is on purchased power and is operated at least one hour per week whether required or not.

Auxiliary Fuel Oil Engine Drive

A 3 by 8 foot reversible fan exhausts 148,000 cubic feet of air per minute at 5.9-inch water gauge pressure. The normal drive is a 200-horsepower 2,200-volt alternating-current induction motor operated by purchased power and connected to the fan shaft by a chain drive and a jaw clutch. The auxiliary drive is a 200-horsepower four-cylinder fuel oil engine, direct-connected by a jaw clutch to the fan shaft. Two men are kept on duty all the time on account of the distant location. From three to seven minutes are required to make the change from the normal to the auxiliary drive in case of a power interruption. The oil engine is started daily and the fan is operated by it at least twice each week. For the test operations, the change can be made with very little variation in the fan speed. When the power is interrupted the procedure is to close the door in the fan duct, light the torches on the oil engine, disengage the clutch on the motor, engage the clutch on the oil engine, and as the fan gains speed open the door in the duct.

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Practices

In the different mines where auxiliary drives or emergency fans are installed and maintained, practice varies to some extent. Some companies maintain that power interruptions in the normal fan power are frequent enough to know that the auxiliary units will function properly when required; others require that the auxiliary power plant shall be operated once or twice a week whether needed or not; and still others require that the auxiliary power shall operate the fan for 1 to 10 hours at a certain specified time each week.

A natural course of events is very noticeable in connection with the use of auxiliary fan drives: All but one of the mines in Alabama using closed lights have some source of auxiliary power for operating the fan; all of the mines with auxiliary fan drives use rock-dust and water as a means of allaying or rendering inert the dust mixture; and all of the mines with auxiliary power units for operating the fans use permissible explosives. This combination of safe practices is convincing in that a number of operating companies are installing and maintaining, without particular regard to cost, the practices and equipment necessary to operate an efficient mine and one essentially safe from widespread explosion disasters. That the practice of having an auxiliary power unit for fan operation is effective was proved when an explosion occurred which disabled the electrical fan drive. The auxiliary fan drive was in operation almost immediately so that normal air flow continued practically without interruption. Unquestionably, in this mine, the auxiliary fan drive was the cause of saving many lives.

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